The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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The Art of Management

IT is recorded that when the Lord Mansfield of a former generation was asked the art of Government, he replied: "Give your decisions, never your reasons; your decisions may be right, your reasons are sure to be wrong." That, judging from the paper on "The Human Factor in Chemical Engineering Processes," given by Dr. G. H. Miles to the Chemical Engineering Group recently, is the antithesis of the modern art of industrial management. The modern method is to treat the workers of all grades as partners in the enterprise whose co-operation is gained by giving them a share in the management through works committees, co-partnerships, and other means.

Dr. Miles discussed chiefly the art of getting the maximum output from a given labour force, in general terms applicable to any industry. This can be achieved in a variety of ways, of which planning based on time and movement studies forms the basis. These studies must clearly be apposite to the type of work investigated, but although probably inapplicable to many of the operations required of workers in the chemical industry, the principles derived from them can be widely applied. The need for eliminating eye-strain is one of these principles. If the various parts of the working space, machine, or table are unevenly lighted, there is a small but cumulative strain involved in the adjustment that the eye must make from one intensity of illumination to another.

The psychologist is on the look-out for such causes of inefficiency and it seems that it will not be long before a psychologist will be considered as necessary in a works as is a chemist. Dr. Miles pleads for something of the sort: "To cope with the problems which these rapid changes (in industrial processes and methods) produce," he says, "already overburdened management needs the assistance of suitably trained and experienced persons who can give their whole time to the details of the human problems as they arise or are discovered." One of the arts of management is thus to employ adequate assistance, and to take advantage of such advances in the science of management as are made from time to time.

A second art of management is that of enlisting the co-operation of the workers instead of driving them as in the past. A certain amount of discipline is essential on all works. The workers themselves expect it, and work all the better for it; it saves them the effort of thinking for themselves. Only the best intellects are good self-starters. On the other hand, workers tend to follow grooves. Because a certain output has always been customary, they cannot be persuaded to increase that output. Because work has been done in a certain way, they suffer from abnormal fatigue if asked to do it another way. The art of enlisting their support for changes or experiments generally resolves itself into taking them into one's confidence and explaining exactly what is the object of the change, and why it will be of advantage to them. That, as will be seen, is the antithesis of Lord Mansfield's dictum. Dr. Miles divided those engaged in industry into two types—the "planners" and the "doers." He suggested that the planners have their work always with them, by day and by night, and are receptive for new ideas at any time; whereas the doers, the labour force, work to hours and forget their work when the whistle blows. According to his paper, it is the doers who need the efficiency expert.

We confess to a feeling that this is not quite fair to the planners. Many of the staff of any considerable business must be among the planners. Efficiency experts seem to believe that these men can always get along very well alone, under their own steam, so to speak. We confess that this is not our view. The loneliness of those in high places is quite considerable. They, too, work all the better if someone takes an interest in their work, gives them a word of encouragement now and again. One of the arts of management lies in keeping the higher staff loyal and enthusiastic. It is so easy to quench enthusiasm, or to turn down an idea without due consideration; too often when unsound ideas are put forward they are rejected brusquely, and the employee, snubbed and disappointed, loses his enthusiasm. It is just as necessary to "nurse" the staff as to "manage" the workmen. The promotion of more intimate contact between staff and workers is also desirable. The engineer must work out his apprenticeship; the chemist during his training is denied his chance of getting to know the mind and thoughts of his fellows. Cannot some scheme to overcome this difficulty be devised?

Management within the factory is, of course, only one aspect of the work of the higher staff; but because the old personal contact that once existed between employer and employed is now severed by a long line of departmental heads, supervisors, and so forth, management has become a higher art—an art that must be learnt. Lord Reith demands that industry shall train men for management; industry, through such men as Dr. Miles, is beginning to understand something of what management of the human factor involves. Total management involves much more than that, of course, and we are beginning to understand that it is in truth a whole-time job, not to be undertaken lightly.

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NOTES AND COMMENTS

Army or Munitions ?

THE communication from Mr. John Roberts, which has been summarised on another page in this issue of THE CHEMICAL AGE, is written by one who has had wide experience of coal mining and who is now concerned with the purchase of coal for the gas industry. Mr. Roberts was, moreover, an Army officer in the last war and may thus be said to know something of all sides of the situation. He indicts the Army authorities on the ground that they prefer a large army to the provision of adequate munitions. There is no possible doubt that he is right, and we are glad to publish his views since they reinforce the pleas made in the Press generally that the provision of coal for the coming winter is of greater importance than the provision of a few thousand additional men in the Army. The War Departments of most nations are staffed by gentlemen of consistently conservative habits of mind, whose experience of warfare up to the last year has, in many instances, been based upon out-of-date campaigns. Industrialists, on the other hand, who are in daily contact with machinery, are better able to visualise the scope of modern war than are many military "leaders." In technical journals before the war it was pointed out that this would be a war of machines, a war in which at least eight and probably more workers behind the lines and in the factories would be needed in order to support one fighting soldier in the field. But the Territorial Army was allowed to expand irrespective of the work that was being done by those who enlisted in that Force. It is true that there has been some circumspection exercised since those days, but it is clear from Mr. Roberts's statement that miners who should never have been allowed to leave the pits are now caught up in the Army and will not be released therefrom. We should not, of course, advocate taking men from the Army into the works unless their special training made it evident that they would be of more value behind the line than in the line. The Army frequently combs out those in civilian occupation. Would it not be both possible and desirable for industry to comb out the Army in order to make sure that the right man was in the right place?

Interchange of Workers

FOR example, just now the coal mines urgently require 50,000 men. Why could they not have been in the mines during the last few months, but regarded as being on temporary leave from the Army in case a sudden emergency should make their presence more essential in the direct fighting line? At the moment steel production is concentrated on the manufacture of special steels and the demand for mild steel is decreasing. There could, therefore, be some temporary release of some steel-workers to replace some at least of the 50,000 miners required. It is authoritatively stated that in every area some machines and men remain idle because at the moment manufacturers have no orders; they do not know how to get orders, and there is no organisation for the letting out of their unutilised capacity. There should be a central authority capable of deciding in these instances whether the men here employed should be drafted temporarily into the Army for maintenance work on tanks and aeroplanes, or whether they should remain at their civilian posts until work could be found for them. This country discovered the machine age in the last century; it has not yet discovered the capacity of the machine age in this. There is still a good deal of industrial power dormant in the nation, and it needs some inspired organisation to bring it to life.

Renovating Copper Acid Stills

BRONZE-WELDING, done on copper plate, was recently employed to excellent advantage by the maintenance operator of a plant which produces acetic acid, wood alcohol, and similar chemical products. Renovation of one of the distilling units included a change in design necessitating the removal of all fittings and line connections and the subsequent patching of a handhole and other openings in the shell. To ensure strength and permanent tightness of the joints, all patches were bronze-welded in place. The section of the still to be renovated measured 5 ft. in diameter and was constructed of 3/16-in. copper plate. When all fittings and connections had been removed from the shell, circular patches for each of the openings were cut from 3/16-in. copper plate. Each of these measured 1½ in. more in diameter than the hole which it was to cover. In preparation for welding, the edges of all patches and openings were carefully ground to clean, bright metal. Additional grinding provided a 1½-in. band of clean metal on the inner side of each patch adjacent to the edges and extending completely around the circumference. Thorough cleaning of all surfaces to be joined was essential in order to obtain maximum strength in the bronze weld. To facilitate welding, the still shell was placed so that each patch could be centred over a hole in a horizontal position, with the cleaned side inward. Since the patches were cut larger than the holes, this left a ¾-in. overlap all round the edges. Because copper has a high rate of heat transfer, a large capacity welding blowpipe was used for bronze-welding each patch to the shell. Before starting to weld, the flame was adjusted to neutral, then made slightly oxidising by slowly closing the acetylene valve until the inner cone was reduced in length by about one-tenth. The operator, using ¼-in. bronze rod and flux, then proceeded to join the patch to the outside of the shell with a fillet weld. When the entire circumference of the patch had been bronze-welded in place, the shell was turned over and an additional fillet weld was made from the inside between the edges of the hole and the cleaned surface of the patch Normal "tinning" and bronze-welding procedure was employed, flux being applied liberally by dipping the heated end of the rod into it and thus carrying it over into the puddle.

The Thai Ministry of Economic Affairs has issued the Report of the Department of Science, Bangkok, for the period April 1, 1936, to March 31, 1938, which shows a steady increase in the equipment as well as in the work of the Department. At the same time appears the October, 1940, issue of the *Thai Science Bulletin* (Vol. II, Nos. 3, 4), which contains an interesting account of a modified method for determining morphine in opium dross. The modification consists in the omission of lead acetate and hydrogen sulphide from the reagents employed in the prevailing method as practised in the F.M.S., and the substitution of petrol (gasoline) for ether. Results were entirely satisfactory.

SULPHUR MINING BY THE FRASCH METHOD

Problems of Heat-Recovery and Corrosion

by D. D. HOWAT B.Sc., A. Inst.M.M., A.I.C., Ph.D.

SULPHURIC acid, one of the basic materials of the chemical industry, is produced from sulphur in one form or another. Originally native sulphur was the only source of SO_2, but with MacDougal's invention in 1870 of the pyrites burner, an important and frequently much cheaper source of SO_2 became available. Prior to the middle of the 18th century the manufacture of gunpowder absorbed most of the available sulphur; thenceforth, however, the sulphuric acid industry, developing rapidly on a commercial scale, became the most important consumer of the element.

Almost the entire world supply of sulphur came from Sicily until the development in 1870 of the Chance-Claus method for recovering sulphur from the residues of the Leblanc soda process. Practically simultaneously a large deposit of sulphur was discovered by oil prospectors in the Gulf Coast district of the United States. In the period immediately following the discovery this district, although eventually to become the most important source of native sulphur in the world (producing over one-third of the total sulphur required by the chemical industry), was the scene of many unsuccessful attempts to mine sulphur. In some of the early mining attempts to overcome the two main problems encountered—quicksands and large pockets of hydrogen sulphide—some very ingenious and novel devices were adopted. First, an attempt was made to sink an outer wooden shaft, within which an inner cast-iron tube was to be contained. In 1886, the National Sulphur Co. essayed to surmount the difficulties by freezing the ground with ammonia refrigeration, a project that never reached even the stage of the construction of the refrigerating plant. Three years later the American Sulphur Co. tried to sink a shaft using the shield process. The shield by some mischance became detached from the shaft and the pit rapidly filled with water. During all these attempts the presence of hydrogen sulphide was a constant problem menacing health and life.

In 1890 Dr. Hermann Frasch, whose contributions to petroleum refining were very widely known and acknowledged, became interested in sulphur mining, taking out the first patent covering the process now so well-known in chemical industry. A merger was effected between the American Sulphur Co. and the Union Sulphur Co. to exploit Frasch's new invention, but a period of over ten years elapsed before sulphur could be produced in quantity. The process is now firmly established in the Gulf Coast district and large tonnages of sulphur are mined annually.

Geology of Sulphur Deposits

Sulphur in the Gulf Coast district of Louisiana is always found in "salt domes." The sedimentary rocks of this district extend to a great depth, and at many points intrusive plugs of sodium chloride appear to have been pushed upwards through the over-lying beds and mantle rock. The topography of the area in the vicinity may not always indicate the existence of a "salt dome," evidence of the occurrence being furnished mainly by various geophysical methods. As indicated in Fig. 1, the top of the plug is usually dome-shaped, the base being composed of salt. Surmounting the salt are a number of strata—anhydrite, sulphur-bearing limestone, barren cap-rock and finally the unconsolidated formation extending to the surface. The domes of intermediate depth (500 to 2000 feet) may carry a thickness of cap-rock of several hundred feet, while the salt plug is generally of unknown depth. The cross-sectional area of the plug may be up to several acres in extent. Oil is frequently found in association with these plugs, the actual discovery of this type of formation being due to petroleum prospecting. The oil sometimes occurs in the cap-rock, but more often in the disturbed sands around the flanks of the domes. The occurrence of native sulphur in these plugs has been the subject of a great deal of theorising, one explanation being the reduction by the oil of calcium sulphate to elementary sulphur and limestone. The actual recovery of the sulphur from these plugs is affected to a very great extent by the contour of the plug, whether high-domed or relatively flat-topped, and by the degree of porosity of the sulphur-bearing formation.

Very early attempts to recover the sulphur proposed the use of certain solvents, but the expense of this method soon rendered it completely impossible. The Frasch process as finally developed comprised the simple idea of melting

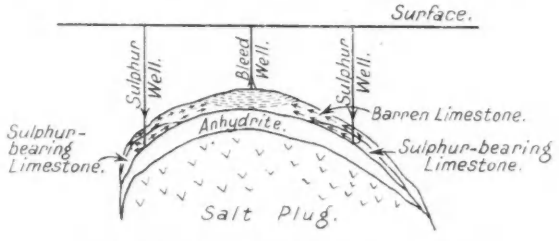

Fig. 1. Typical cross-section of salt plug at Hoskins Mound, showing sulphur-bearing formation on flanks of dome and flow of hot water (McIver, Chatelain and Axelrad)

the sulphur underground by means of water superheated to a temperature above the melting point of sulphur. The porous sulphur-bearing limestone allows the hot water to reach and melt the sulphur, which thus accumulates at the bottom of the well, to be raised to the surface by an air lift.

The sulphur well is drilled by a "rotary rig" in a manner exactly similar to that used for oil wells. On reaching the cap-rock a 10-inch-diameter steel surface casing is set and cemented into place. Drilling is then continued within the surface casing, the well finally extending down to the barren anhydrite strata. Three sets of pipes are then arranged concentrically within the well. The outer 8-inch-diameter hotwater pipe extends right down to the bottom of the well. Hot water is forced down this pipe, escaping outward into the sulphur-bearing strata through perforations in the lower reaches of the pipe. The molten sulphur, draining to the foot of the well, flows through the lower perforations to the air-lift pipe. Arranged concentrically within the hot-water pipe is a 4-inch sulphur pipe, extending almost to the bottom of the well and serving as the air-lift for the molten sulphur. Compressed air is admitted near the bottom of the 4-inch pipe by a central 1¼-inch line. The general arrangement of the well and pipes is shown in Fig. 2.

The sulphur melted by the injection of the superheated water gradually percolates down through the deposit collecting at the bottom of the well. When the liquid sulphur is deep enough to seal off the end of the 4-inch pipe, compressed air is admitted and the sulphur rises through the 4-inch tube by the air-lift so formed. Should the sulphur level fall below the end of the tube, hot water is blown to the surface by the air-lift. Air is then cut off and hot water admitted through both the 8-inch and 4-inch pipes until a sufficient quantity of molten sulphur has again accumulated to restore the seal at the bottom of the air-lift.

The pores in the limestone formation are filled originally with "formation water," a solution of sodium chloride together with calcium and magnesium bicarbonate, sulphide and sulphate ions. During the removal of the

sulphur the hot water forced into the cap-rock dilutes the formation water present and fills up the spaces from which the sulphur is melted. The volume of water pumped into the plug during mining is very much larger than the volume of sulphur removed and a consequent rise in pressure takes place. To prevent the build-up of pressure,

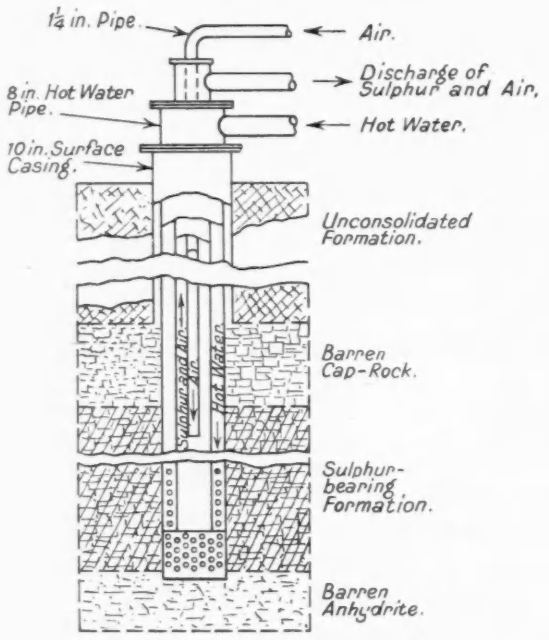

Fig. 2. Arrangement of pipe-lines and flow of material in a sulphur well (McIver, Chatelain and Axelrad)

controlled volumes of water are withdrawn from the formation. This " bleed water " is composed of the formation water originally present diluted with the feed water. The bleed wells are usually located at points where the coldest water may be exhausted and the formation pressure controlled, the site being so selected that no channelling of water occurs from the actual mining well. The position of the bleed wells in relation to the mining wells is illustrated in Fig. 1, which also indicates the direction of flow of the mine water. Two problems are constantly being encountered—first, the provision of a suitably softened and purified water for use in the boilers and the superheating plant and second, the conservation of the heat and the re-use of bleed water in the mining process.

Treatment of Boiler Water

A large and constant water supply is an absolute necessity in a sulphur-mining plant, the raw water being usually obtained from both rivers and wells. In the Newgulf plant water is stored in a large reservoir holding over a billion gallons, thus covering the periods when the San Bernard river is low. In the early days of the industry rudimentary softening plants were employed, but these have gradually been replaced by modern hot-press installations, provision being made for deaëration and final conditioning in the boilers. At one of the largest plants in the Newgulf district, six Cochrane hot-process softening units have been installed, each capable of treating 70,000 gallons per hour. The addition of sodium sulphate to the water supply is necessary to raise the sulphate/carbonate ratio to a value that will prevent caustic embrittlement of the boiler plates. Deaëration is effected by the addition of sodium sulphite, and the prevention of silicate scale by the addition of a trade phosphate.

The water pumped underground to melt the sulphur in the deposit, subjected first to a partial softening in hot process units, is then super-heated to a temperature of 150°-160°C. with live steam. Although the condensation of steam dilutes the quantities of salts present in the water, the increase in the temperature may cause a decided decrease in the solubility of certain salts of calcium and magnesium. At these temperatures corrosion is severe unless the pipes are protected by a thin layer of scale or the water highly deaërated. Addition of lime causes precipitation of most of the salts, the sedimentation period required being about one hour. After final filtration through calcite filters the water is sent to the superheaters from which it is pumped through 16-inch pipe lines to the main surface workings.

Treatment of Bleed Water

Of the total heat contained in the superheated water only about five per cent. is actually employed in melting sulphur in the deposit, the thermal efficiency of the process being obviously very poor. Loss of heat is due to two main causes: the large amount of heat required to raise the temperature of the entire sulphur-bearing formation above the melting point of the element, and the heat lost in the bleed water. A consideration of the process will show that the hot water pumped into the sulphur-bearing strata will, in spite of the porosity of the material, soon build up a hydrostatic pressure considerably in excess of the capacity of the surface pumps. To relieve the pressure the hot water in the formation is drawn off through bleed wells. In many cases the hydrostatic pressure may be allowed to build up to the point at which the water flows from the bleed wells in sufficient quantity to balance the mining water input. Pumps may, however, be necessary under certain circumstances. Recovery of the heat in the bleed water would render possible a tremendous increase in the thermal efficiency of the entire process.

The highly corrosive nature of the bleed water makes either the recovery of the waste heat or the re-use of the solution a matter of considerable difficulty. The hot mine water reacts with the calcium carbonate, calcium sulphate, sodium chloride, sulphur, and other chemicals. Hydrogen sulphide, formed along with other substances by the chemical reactions, gives rise to severe corrosion of steel or cast iron. If pumps are necessary to lift the bleed water from the wells, naval bronzes or other suitable non-ferrous alloys must be used. Even disposal of the bleed water is not simple, as it may not be led into the ordinary fresh water streams until the chemicals injurious to plant and animal life have been removed. Two methods of removing the sulphides from the bleed water have been tried out, namely, aërating the solution in the presence of small quantities of nickel salts acting as catalysts, and scrubbing the solution with flue gases. The first method was used at one of the larger mines for some years, but it has been gradually replaced by treatment with flue gases from the heating-plant boilers. The carbon dioxide in the flue gases used for scrubbing maintains the water at a constant pH value of 7, sulphides being completely removed as hydrogen sulphide after a few minutes' scrubbing. At the Newgulf plant, five 1750-gallons-per-minute scrubbing units have been installed. Each unit consists of two Redwood towers, 18 ft. diameter and 40 ft. high, down through which the water passes counter-current to the gases, 4 to 5 cubic feet of flue gas being required per gallon of bleed water treated. The water from the scrubbers is then led to the tidal stretches of the river through a 20-mile disposal ditch.

Simple methods of recovering the heat from bleed water have been attempted, the commonest being to pass the water through corrosion-resistant heat-exchangers in which the heat is transferred to fresh water (which becomes preheated). To reclaim and recirculate the bleed water is obviously the most efficient method of utilising the heat. At their Hoskins Mound plant the Freeport Sulphur Company, New Orleans, have devised and erected a large-scale plant for the reclamation and treatment of bleed water to ensure its recirculation through the deposits. The diagram of Hoskins Mound (Fig. 1) shows that the structure is ideally suited for the recovery of the bleed water, large volumes of which at a temperature of 105°-120°C. may be taken from the top of the barren cap-rock. The bleed wells are drilled into the porous barren limestone at distances varying between 500 and 3000 feet from the sulphur

wells. The bleed wells are fitted with a steel casing, the water rising because of the formation pressure and flowing through cast-iron pipes to the relay station. The water, delivered to the relay station at a pressure of 30 lb. to 60 lb./sq. in., is pumped by centrifugal pumps into tanks in which it is mixed with the plant water at 180°C., the temperature of the resulting solution falling to the correct value for mining. The proportion of fresh water to bleed water commonly employed is 60 to 40.

In an extensive study of the problems of reducing the corrosive action of the bleed water, three members of the staff of the Freeport Sulphur Company devised the following possible methods, the first two of which proved successful on a commercial scale, the third being still in the experimental stage.

1. The addition of alkaline chemicals in amounts sufficient to cause the required change in the solubility of the dissolved compounds to effect a deposition of scale on the metal surfaces, which are thereby sealed off from the corrosive action of the water.
2. The addition of chemicals which will combine with ions already present to form an insoluble precipitated scale on the metal.
3. The removal of sufficient of the dissolved gases to render the solution non-corrosive.

Protective Scale Formation

If hydrated lime is injected into the bleed water in amounts sufficient to raise the *p*H value to 6.9/7.1, precipitation of an insoluble scale of calcium carbonate takes place. With a greater degree of alkalinity the precipitate is sludgy, and in a more acid solution no scale forms. The conditions attending the formation of the calcium carbonate scale are rather critical, and other chemicals must be added to reinforce the action of the lime producing a permanent scale, which will be neither too bulky nor too easily soluble with variations in the *p*H values of the solution. Trisodium phosphate and barium chloride have been found very successful in this respect, giving, when added to bleed water, a scale composed approximately of 25 per cent. of baria, lime, and sulphur trioxide, with about 15 per cent. of phosphorus pentoxide. The alkaline phosphate/barium chloride treatment is necessary for the protection of metal parts which are permanent, while in lines and wells which are not permanent a scale composed mainly of calcium carbonate has been found satisfactory. The usual practice in protecting the metal pipe lines and parts is first to inject the necessary alkaline phosphate/barium chloride mixture of chemicals at a point 300 to 800 feet down in the bleed wells. When sufficient protective scale has been formed, lime is added in the quantities required to maintain the *p*H value at about 6.9 or slightly lower. Under these conditions the initial protecting scale is not dissolved nor does additional carbonate scale deposit in the bleed-well system and pipes. As a further effect of the lime additions a protective carbonate scale is formed at distances of 500 to 3000 feet in the steel pipe lines feeding the producing wells.

Injections of the necessary chemicals in the form of a slurry must be made at different points in the pipe-line system by positive-displacement reciprocating pumps. These pumps must be capable of delivering against pressure which may vary from 30 to 250 lb. per sq. in. in the collecting or feeding pipes.

Some more recent work appears to indicate that it will be practicable to raise the temperature of the bleed water from 105°-120°C. to about 160°C. by condensing steam into it under pressure in a suitably constructed heater. By this method up to 90 per cent. of the total mining water used will be reclaimed bleed water.

From the producing wells the sulphur discharges into collecting sumps, 6 ft. deep and 20 ft. square. These sumps are lined with cast-iron plates and heated by steam coils. The sulphur is pumped through cast-iron pipes by multi-stage centrifugal steam-jacketed pumps to the large storage vats, two or three miles from the wells. At the Newgulf plant the storage vats are 1200 ft. long, 160 ft. wide, and 50 ft. high, older types being built with wooden sides. A recent modification in the design employs galvanised sheet metal sections to form the sides. As the layers of sulphur solidify they become perfectly rigid and the sheet-metal sections are raised and used over again. For shipment the sulphur is broken from the vats by blasting and loaded by grabs into cars. A large part of the sulphur is shipped from Galveston to the various consuming centres in the United States of America.

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U.S. Pat. No. 2,109,611.

LETTER TO THE EDITOR

Education for Management

SIR,—Thank you for your leading article—Education for Management—in your issue of July 19. The operative word therein is "consciously," used in Lord Reith's injunction to the chemical industry that it should consciously train men for management.

When it is understood that the function of management is to resolve men, money, machines and materials in terms of the highest service to the community, it will be realised that such an important task calls for men of no mean attainments and qualifications, which are neither born with them nor absorbed by any process of industrial intimacy. The technique of management can be acquired only through appropriate and adequate education and training.

The test of management is not so much a matter of overcoming war-time emergencies, as of solving the grave problems which will confront industry in the years immediately following the end of the war, when the whole of the industrial and social structure of the country will be in the melting pot.

Lord Reith and others who call attention to the need for education and training for management are sounding a warning which, it is to be hoped, will be heeded in time by those still in the dark about the future of management and, therefore, the future of British Industry.—Yours faithfully,

H. N. MUNRO.

The Institute of Industrial Administration,
London, S.W.1,
July 30, 1941.

Methanol as a Substitute for I.M.S.

Danger of Pharmaceutical Use

THE Controller of Molasses and Industrial Alcohol has sent a circular letter to all persons holding a permit to purchase industrial methylated spirit, suggesting that in certain industries it might be possible to substitute methyl alcohol (methanol). The letter emphasises the necessity of conserving supplies of I.M.S. and of the desirability of finding, wherever possible, a suitable alternative solvent. "At the present time," the letter reads, "Industrial Methylated Spirit Grade III is available made up of equal volumes of standard quality industrial methylated spirit and methanol, and has been used as a substitute for industrial methylated spirit. In addition, it is now intended that specially denatured methanol should also be made available for the time being."

It may be possible to use I.M.S. containing methyl alcohol, or methanol itself as a solvent in the extraction or purification of certain fine chemicals, but the reference in the letter to the toxic character of the substance, absolutely precludes its use in any pharmaceutical preparation to be administered internally or applied externally.

War-Time Fuel Policy

A Demand for Resolute Action

THE CHEMICAL AGE has consistently backed up the demand that the Government should adopt a realistic coal policy, especially in the light of the difficult position likely to be encountered next winter. We have received from Mr. John Roberts, D.I.C., M.I.Min.E., F.G.S., a reasoned analysis of the basic cause of the coal shortage and advocating the adoption of a fuel and labour policy which will remove the present difficulties.

Mr. Roberts points out that the Army authorities, still mentally in the days of mass armies, continue to regard the absorption of men into the Fighting Services as being of the first importance, and are not yet alive to the fact that man-power behind the lines, in the factories and in the mines, is equally important. There may have been some excuse for this belief before the war when we encouraged miners to enlist in the Territorials, but even so the experience of 1914-18 should have led to a better understanding. From one well-equipped colliery which produces first quality coal in great demand for munition factories and public utility undertakings, close on 400 men were allowed to join the Forces. At least 90 per cent. of these men would have been more usefully employed in coal getting.

The miners have responded splendidly to the heavy demands made upon them for increased coal production since the start of the war, but the reduced man-power available at the collieries cannot maintain this high rate of effort indefinitely for reasons of health; reinforcements have now become vitally necessary. Miners should, therefore, be sent back from the Army into the pits.

The high wages to be earned in munition factories have also attracted men from the mines. This transference of labour was allowed to continue without hindrance until the passing of the recent "Essential Work Order." The collieries were powerless. Prior to the passing of this order the prime difficulty was that collieries are industrial concerns which have to work under economic laws, while many munition factories operated on the "cost plus" system, so roundly condemned by subsequent Treasury committees, and could therefore afford to pay wages impossible in normally regulated industries. Miners in the munition factories should be re-transferred to the mines where their services are so urgently needed.

The production of explosives is obviously a munition industry of the very highest importance. What would be the reaction of the Cabinet if Ministers demanded that the workers in an explosives factory should be enlisted for the Fighting Services? In the manufacture of many explosives toluene is the essential basic material. Toluene cannot be produced without coal, thus the gas and coke oven industries must have extra coal if they are to make the raw material for explosives; otherwise, they cannot afford to extract benzene and toluene from the gas. The mine managers cannot produce this extra coal because Colonel Blimp holds on to the miners. It is he who is responsible for the bottleneck in the whole enterprise.

Fuel Production Director Suggested

In the circumstances Mr. Roberts calls for a Director of Fuel Production. He notes that we are not making full use of the benzol recovery plants that we have and asks: "Is there no one big enough or sufficiently determined to put this matter right? Why should we not have as Director of Fuel Production a capable man who would brook no undue interference, and brush aside all unnecessary obstacles?"

The psychological reaction of the miner must also be considered. He must be convinced of the urgency of coal production and he must be made to feel that others are also pulling their weight and that the Government is really in earnest. Nothing discouraged the colliers more during last winter than to find when they presented themselves for work that there were not sufficient waggons available to absorb their potential output. To put it plainly, they refused to believe that output really mattered because superficial facts pointed in the other direction. Now they are told that the men who can help them make up the sufficiency in coal are not to be allowed to return from the Army to the pits. This position must inevitably revive their doubts as to the sincerity of the appeals which are being made.

This state of affairs must be rectified immediately. The release of one miner while the days are long and transport services are functioning reasonably well, will be worth two miners released when the transport services are more liable to interruption. The Minister of Labour has been asked to use his influence to secure the release of about 50,000 miners from the Forces. Doubtless he has tried his best, but he has not succeeded. Let us consider what difference it will make when he does succeed, as succeed he must if he is sufficiently determined. Those extra men will produce an output of about 75,000 tons of coal per day. This is equivalent to the output of 75 large pits, or a coalfield of a decent size. The annual output this represents is 22 million tons, which is ½ ton per head of population, or more coal than is at present carbonised by the whole of the gas industry. The Secretary for Mines says, quite truly, that he needs an additional 20 million tons per annum. It is in the power of the Cabinet to make him a present of it, if they will give the order to the Military. The coal is there, the machinery and equipment are available, the output capacity is there. All that remains is to provide the men. Go to it, Bevin, go to it!

Thermal Studies on Asbestos

Moisture Effects and Breaking Strength

RESULTS of three groups of thermal studies on asbestos have been reported by the National Research Council of Canada (*Canad. Chem. and Proc. Ind.*, 1941, *25*, 6, p 342).

In studying the effect of temperature and time of heating on loss in weight and resorption of moisture, heating a chrysotile asbestos mill fibre has shown that, in the approximate temperature range of 500°-700° C., the loss in weight depends on both the time and temperature. At other temperatures the loss is practically independent of the time. Prolonged heating at about 490° C. expelled about 25 per cent., and at 510° C. about 50 per cent. of the combined water. Complete dehydration occurred on prolonged heating at about 580° C., but only above 700° C was the loss in weight rapid. On the basis of data obtained on the resorption of moisture, it is suggested that heating for 30 min. at 215° C. would be a more accurate and rapid method for determining free moisture than that commonly employed.

Investigations on the effect of heat on the breaking strength of asbestos tape and glass fibre tape show that an increase of breaking strength results in pure chrysotile asbestos tape, crocidolite asbestos tape and glass fibre tape. Pure chrysotile tape does not lose strength until a temperature of 370° C. is exceeded. Prolonged heating at 430° C. causes a loss in strength of about 20 per cent., and at 480° C. a loss of about 40 per cent. is observed. Heating at 540° C. causes a rapid loss in strength. Crocidolite asbestos tape loses strength more rapidly than chrysotile. Glass fibre tape, though initially stronger than chrysotile tape, is considerably less resistant to heat, beginning to lose strength rapidly at about 250° C.

Studies of the effect of heat on the breaking strength of asbestos cloth containing cotton indicates that Commercial, Underwriters', and "A" grades of asbestos cloth begin to lose strength as soon as heat is applied. On heating for 5 minutes at 300° C., these three grades respectively lose about 60, 35, and 25 per cent. of their original breaking strength.

Indian Tannin Materials for Ink Manufacture

The Preparation of Gallic and Tannic Acids from Touri

by R. L. DATTA, D.Sc., S. C. SEN, M.Sc., and L. K. DE, M.Sc.

SYSTEMATIC examination of Indian tannin materials with reference to ink manufacture reveals that touri (*Cæsalpinia digyna*) is the simplest tannin material so far examined, and is suitable not only for the manufacture of good writing ink, but also for the preparation of gallic and tannic acids. The tannin in touri has a similar constitution to that contained in gall-nuts. As with gall-nuts, its unhydrolysed extract, containing larger proportions of tannic and smaller proportions of gallic acid, can be used directly in the manufacture of ink after suitable maturing under preservatives, and is the only raw material available in India that can be so used, *i.e.*, by extraction without fermentation. The plant is obtainable in plenty in India and is a product of the Assam jungles. Touri extract can also be hydrolysed with fermentation to yield an extract containing more gallic than tannic acid, and in the process there is much fall in astringent strength. Such extract can also be used for the manufacture of ink with suitable corrective additions of tannic acid.

Divi-divi (*Cæsalpinia coriara*) and myrobalan (*Terminalia chebula*) are the next best Indian raw materials for the manufacture of ink. The tannins in these raw materials are more complex than the tannin in touri, and these can be used in ink manufacture only after fermentation and hydrolysis in which process there is considerable fall in the value of the astringent acids in the extracts owing to the separation of much insoluble matter. Jangi, or black myrobalan, and amlaki (*Phyllanthus emblica*) have been examined, and it has been found that on account of their low tannin content they are less suitable for the manufacture of writing ink. Bahera (*Terminalia belerica*), babul pods (*Acacia arabica*) have likewise been found unsuitable in ink manufacture on account of their very complex nature and poor tannin content. The matured normal extract from touri and the hydrolysed and fermented extracts from the other raw materials were used in practical inks. Touri extract gave satisfactory ink and the other raw materials gave inks that were darker or brighter, and in some cases possessed a faint red fluorescence.

Extraction of Acids

The extraction of astringent acids from the raw material is best effected by crushing the latter into small pieces passing through, say, a 12-mesh sieve, steeping in 4-5 times the quantity of hot water and heating for 2 or 3 hours at a temperature of 70° C. After securing the main extract, the residue is further extracted with smaller quantities of water to complete the extraction. The extract thus obtained contains some gallic acid and a predominant proportion of tannic acid. At this stage it will be found to be cloudy and should be allowed to mature for some months before it is used for the manufacture of ink. During maturing, preservatives, say, 0.05 per cent. thymol and 0.1 per cent. acetanilide, should be used. The percentage of gallic acid formed during the extraction is not constant and will vary slightly with the conditions of extraction. In the process of maturing, slow hydrolysis of tannic acid to gallic acid takes place with the separation of insoluble deposits. Before compounding the ink, the extract is analysed for its actual content of tannic and gallic acids. The permanganate method of estimating total astringents and the gelatine method of separating tannic acid are employed.

Extraction with fermentation is the method that should be used with the more complex raw materials whose extracts cannot be used directly for the manufacture of ink. The crushed material as above is steeped in five times its weight of water, the optimum strength in which fermentation and hydrolysis proceed satisfactorily. The water gradually extracts the soluble tannin matter with the progress of fermentation and mould is formed. As the fermentation proceeds, the percentage of gallic acid increases with some loss of tannin astringents originally present in the raw material. It has been found that for practical purposes of ink manufacture, it is usually sufficient to allow the fermentation to proceed for a fortnight; continuation of the process for longer periods will lead to useless loss of astringent matter. Next, the extract is secured and is found to contain more gallic acid and less tannic acid and should be matured for prolonged periods, first in open containers and afterwards in closed containers with the addition of preservatives. The matured extract can be used for compounding ink on its own astringent value or with corrective additions of tannic acid.

A Cheap and Abundant Source

Touri offers a very cheap and abundant source of tannin. The yield of pericarp is 56-60 per cent. of the pods. On extraction with hot water (60-70° C.) and analysis on the following day, it gave a 45 per cent. total yield of astringent acids as follows: gallic acid 16.58 per cent., tannic acid 28.42 per cent. On fermentation and hydrolysis for 15 days, the total yield of astringent acids was: gallic acid 27.22 per cent., tannic acid 5.75 per cent. (total 32.97 per cent.)

With the other raw materials mentioned, the total content per cent. of astringent acids on ordinary extraction and the final astringent acids after hydrolysis and fermentation for 15 days are given in the attached table :—

Material	On Extraction with Hot Water			On Fermentation and Hydrolysis		
	Gallic Acid	Tannic Acid	Total	Gallic Acid	Tannic Acid	Total
Divi-divi	10.84	37.66	48.50	17.96	8.18	26.14
Myrobalan ...	10.48	32.35	42.83	15.08	7.55	22.63
Jangi or Black Myrobalan ...	6.22	32.57	38.79	13.01	8.57	21.58
Amlaki	15.18	7.59	22.77	14.07	2.73	17.70

It will be seen that the fall in the strength of original astringent acids on hydrolysis is high, owing to the complex nature of the tannin contained in the materials.

Touri pods are a cheap material for the commercial production of gallic acid. A typical experiment is given below. Of the ground material 3158 gm. are steeped in 15,790 c.c. of water and allowed to ferment for 15 days. The extract is secured by filtration and the residue is washed with small quantities of water and added to the main filtrate; 15,000 c.c. of extract is obtained, having a density of 8.7° Tw. at room temperature. The extract is next evaporated over a water-bath heated to 80° C. to a density of 34° Tw. On cooling, crude crystals of gallic acid separate. The mother liquor after the crystallisation of crude gallic acid contains all the tannic acid and some gallic acid. This is evaporated for a further crop of gallic acid. The mother liquor, which will be found to thicken considerably, will again contain all the tannic acid and some gallic acid, and is best used for the manufacture of ink. For this purpose it is diluted to 8° Tw. and allowed to mature, with the addition of preservatives. Better results will be obtained by evaporating the extract under vacuum. The crude gallic acid is best recrystallised from water with the addition of small quantities of animal charcoal or activated carbon. The yield of pure gallic acid obtained is 12.6 per cent. The gallic acid was identified by preparing its acetyl derivative.

In the above method, there is the disadvantage of some darkening of the extract incidental to evaporation for the recovery of gallic acid. The following method will be found expedient for the manufacture of gallic acid, yielding at the same time an extract suitable for manufacturing ink. The extract as obtained directly after fermentation and hydrolysis for 15 days will usually have a density of 15° to 20° Tw. This extract is allowed to stand with preservatives, when it will eventually be found

to deposit copious precipitates of gallic acid. The precipitates are secured and crystallised, giving pure gallic acid and the extract, which will have fallen in density, is allowed to mature in closed containers as usual. Any further precipitate formed should be recovered and crystallised for gallic acid. The matured extract will be very suitable for ink-making.

Touri contains tannic acid in its simplest form as is found in gall-nuts. It is a good raw material for the commercial preparation of tannic acid. Touri is extracted with water, and the extract is next fractionally precipitated with lead acetate with a view to removing some colouring matter and some complex tannins that may be present. The extract is next concentrated under reduced pressure. The concentrated extract is then saturated with common salt and extracted with ethyl acetate. On evaporating the ethyl acetate extract in vacuum, a light brown tannic acid is obtained. If the addition of salt is continued to the filtered extract until a permanent precipitate of tannic acid is formed and the filtrate after the separation of precipitated tannic acid is extracted with ethyl acetate, a better and paler acid is obtained. The slimy tannic acid precipitated by salt is mixed with sand and extracted with ethyl acetate, when an inferior product is obtained. The result of a typical experiment follows: 1000 gm. of touri is extracted with water, to give 6200 c.c. extract of 6.1° Tw. The extract is fractionally precipitated by 10 gm. lead acetate dissolved in 1500 c.c. water, the lead acetate solution being added slowly with constant stirring. The precipitates are filtered off. The extract is next concentrated under reduced pressure to 1580 c.c. at 19.5° Tw. The concentrated extract is treated with a saturated solution of common salt until a permanent precipitate is obtained, and is then filtered. The filtrate is extracted with ethyl acetate and the ethyl acetate extract is evaporated to dryness under reduced pressure, when a very light buff coloured product is obtained. The yield is 182 gm., or 18.2 per cent. The tannic acid precipitated by salt is mixed with sand and extracted with ethyl acetate. The extract is evaporated to dryness under reduced pressure when a somewhat heavier and darker product is obtained. The further yield is 18 gm., *i.e.*, 1.8 per cent., making a total yield of 20 per cent.

Bacterial Purification of Gas

Use of Peat-Oxide Mixtures

By M. P. APPLEBY and J. HUGHES*

WITH the interruption of supplies from some of the normal sources, the question of iron oxide for gas purification has become a matter of some concern, while any wide extension of gas purification, *e.g.*, to coke ovens, has not been a practical possibility, however desirable it may have been from the point of view of the national sulphur requirements. It may be advantageous, therefore, to have information about experiments which have been undertaken by Imperial Chemical Industries, Ltd. These experiments indicate that the use of iron oxide may be substantially reduced by employing bacterial action. It is our intention eventually to publish a detailed account of our work, but we think it advisable to anticipate this by a preliminary statement.

We have found that sulphur bacteria, such as are almost invariably present in peat, can be used very effectively for the oxidation of hydrogen sulphide to sulphur if the correct conditions for their activity are observed. These conditions are not difficult to secure and in some respects give more latitude than oxide purification as normally practised.

The origin of our observations was an attempt to lighten and reduce pressure drop in oxide boxes by the use of peat. This is, of course, a well-known device. In pursuing our investigations, however, we found improvements in efficiency of purifiers much in excess of what might be expected from any such mechanical effect, and we observed that the amount of peat mixed with oxide could be raised to very high proportions with no diminution in efficiency. This result was finally traced to the presence of sulphur bacteria, whose characteristics we are now investigating, which were found to be present in the peat used and which were actively producing sulphur in the boxes. Finally, the conclusion was placed beyond all doubt by running an experimental box, filled with peat alone, which acted as an efficient purifier for a considerable period, during which elementary sulphur accumulated in the peat to a final figure of 70 per cent.

We find that the best practical application of this discovery is to use a mixture of oxide and peat, which we have used in our full-scale boxes at the Billingham plant for many months. These have been charged chiefly with a mixture of 50 per cent. peat and 50 per cent. low-grade spent oxide (by volume). Purification of water gas to the degree required for subsequent processes is proceeding very satisfactorily. There has been no development of excessive pressure drop, the purchase of new oxide has been much reduced and a means has thereby been found of converting the low-grade spent oxide, which had previously been disposed of as valueless, into a material of high sulphur content which is readily saleable. The addition of more fresh peat to this spent peat-oxide mixture produces a mass whose activity and sulphur-removal capacity are as good as those of the original mixture, and results in a finally spent mass of yet higher sulphur content.

We have no large-scale experience of bacterial purification of coke-oven gas, but the results of small-scale experiments lead us to believe that the bacterial method will be just as effective with this gas as with water gas.

As to conditions, it is necessary to supply a small quantity of ammonia to the bacteria, but this is already common practice with oxide boxes. We find, for example, that with water gas containing 0.3 per cent. H_2S, we obtain good results with a concentration of 0.03 per cent. of ammonia in the gas entering the boxes. Peat and peat-oxide mixtures are much less sensitive to temperature changes than boxes containing oxide alone. The activity of peat itself is as great at 10° C. as at 30° C. and is only slightly reduced at 4° C.

It should be stated finally that our efforts have been directed to purification of gas for industrial purposes for which the final sulphur content does not need to be so low as for town gas supplies. It is possible to obtain trace removal of H_2S with peat and peat-oxide mixtures under suitable conditions; whether this degree of purification can be achieved consistently in the large-scale purification of town gas remains to be seen. With a series of boxes such as is usually available, it would be possible to ensure a satisfactory final purification by filling the last box of the series with oxide.

Inquiries for further particulars may be addressed to: The Research Manager, Gas and Power Section, I.C.I. (F. & S.P.), Limited, "Willowmere," Hartburn, Stockton-on-Tees.

* Research Manager and Gas and Power Works Manager, respectively, of I.C.I. (Fertiliser and Synthetic Products), Limited.

Messrs. Stewarts and Lloyds of South Africa, Ltd., supplied tubes and fittings for the new 100,000-ton reduction plant of the Western Reefs Exploration and Development Co., at the Klerksdorp goldfield in the Rand. These were manufactured at the company's Vereeniging works from local steel. As local representatives of Worthington-Simpson, Ltd., they also supplied the air compressor.

Components of an "Explosive Oil"*

The Problems of Differentiation

OWING to the comparatively high freezing point of nitroglycerin—1.9° C. and 13.0° C. for the labile and stable modifications, respectively—manufacturers of dynamite, in order to depress the freezing point, have incorporated into the liquid portion of these composite explosives various substances capable of participating in an explosion. Aromatic nitrocompounds, chiefly nitrobenzenes, nitrotoluenes, and nitronaphthalenes, have been used to a considerable extent, but such nitrosubstitution products have not proved altogether satisfactory, as has been clearly shown[10]. Consequently, there has been a strong tendency in recent years to replace them with one or more of several nitric esters, among which the following have been prominent: Dinitrochlorhydrin (monochlorhydrin dinitrate); nitrosugars, for example, sucrose octanitrate; tetranitrodiglycerin (diglycerin tetranitrate); nitroglycol (ethylene glycol dinitrate); and diethylene glycol dinitrate. Of these, nitroglycol is outstanding in importance. The following report brings together the widely scattered experimental work covering the problem of differentiation that has appeared in various publications on the analytical chemistry of "explosive oils."

Apart from the determination of moisture, the analysis of dynamites (and permissible explosives) consists in removing the constituents, group by group, with appropriate solvents, whereupon the matter taken out in each extraction may be examined further. The first solvent to be applied is generally ether, which completely dissolves the nitric esters and aromatic nitrocompounds and, incidentally, any resins or greases that may be present—also a moderate amount of sulphur. After the ether is expelled by evaporation at a low temperature, the weight of the dried residue is recorded. Similarly, a duplicate sample is extracted in order that material may be available for estimation of the sulphur, resins, etc. Disregarding, for the time being, the latter substances, which are inclined to be present in small quantities only, there is still the possibility that the "explosive oil" may be composed of one or more of the aromatic nitrocompounds, which may exist in both the solid and the liquid phase; moreover, at least one of the other nitric esters may be dissolved in the nitroglycerin. In fact, one separated "oil" was found to contain five ingredients: nitroglycerin, nitroglycol, nitrosugar, tetranitrodiglycerin, and nitrotoluenes (according to a communication from J. E. Crawshaw, Bureau of Mines, Explosives Experiment Station, Bruceton, Pa., March 21, 1940); however, this degree of complexity is very unusual. The true nitrobodies are used much less than formerly, and of the esters dinitrochlorhydrin and tetranitrodiglycerin are said to be less efficient as depressants than nitroglycol. Even when the preliminary examination has shown that the nitrosubstitution compounds are absent, differentiation of two or more of these aliphatic nitrate esters is no easy task, for it cannot be said that any really satisfactory analytical process is yet known.

Determination of Nitrogen

The nitric nitrogen may be determined by any of several methods (conveniently with the nitrometer), and, the weight of the "explosive oil" as a whole being known, that of the nitrocompounds may be calculated. It is obvious, however, that until such a procedure can be amplified it is limited to mixtures in which only one ester of established identity (say nitroglycerin) is present. Moreover, the nitrometer should not be employed if mononitrobodies form part of the material under test, because, under prevailing conditions, further nitration has been demonstrated to take place with some of these substances. It is also interesting to note that nitroamines evolve nitric oxide when in contact with mercury and sulphuric acid.

The total quantity of nitrogen may be determined by Kjeldahl's process, suitably modified[3], and the nitric nitrogen, which has been estimated independently, may be deducted from this total. The remainder is the nitrogen of the nitrosubstitution compounds. Another procedure for determining the entire quantity of nitrogen has been developed by Berl and Jurrissen[1], in which they make use of their "Zersetzungskolben," or decomposition flask—an instrument that serves much the same purpose as the generating bulb of a nitrometer. After a preliminary treatment with chromic and sulphuric acids, all the nitrogen is converted to nitric oxide regardless of its mode of linkage in the original compounds.

An ingenious method for separating nitrosubstitution compounds from nitroglycerin has been reported by Hyde[8]. The process depends upon the preferential solvent action of carbon bisulphide on the true nitrocompounds and similarly that of aqueous acetic acid (about 75 per cent.) on nitroglycerin, the two liquids being nearly immiscible. Hyde's test analyses, in which he employed several different nitrobodies, are excellent, but as he experimented with no nitric esters except nitroglycerin, little or nothing seems to be known regarding the deportment of the other organic nitrates now being used in explosives. Furthermore, the apparatus is rather elaborate and the technique exacting.

Busch's reagent ("nitron") is available for gravimetric estimation of nitric acid and its inorganic salts; hence any nitric ester that can be saponified satisfactorily may be determined with its aid. "Nitron" is a basic organic compound having the formula $C_{20}H_{16}N_4$, whose nitrate is only very sparingly soluble in water. Although certain nitrocompounds give no precipitate with this reagent and may therefore be expected to pass into the filtrate, others yield insoluble addition compounds, as pointed out by Cope and Barab[1]. Accordingly, this chemical has very restricted applicability, as far as the parting of these two classes of organic substances is concerned.

Gravimetric Method

A method that permits gravimetric determination of nitrobody mixtures is that of Dickson and Easterbrook[5]. In accordance with their adopted procedure, the residue from the ether extract is dissolved in methyl alcohol, which prevents further nitration of the nitrocompounds, and the nitroglycerin is decomposed with ferrous chloride in the presence of hydrochloric acid. The reactions take place at room temperature, but require some 24 hours for completion. The resulting solution is extracted with ether, and this extract is washed free of iron salts, dried, and filtered. The ether is removed by evaporation, and the remaining substances (nitrocompounds, presumably) are weighed after being thoroughly desiccated *in vacuo* over sulphuric acid. The results obtained reveal only a fair degree of accuracy.

The oxidimetric estimation of the nitric acid that forms when a nitrate ester undergoes hydrolysis has been studied by several investigators. Obviously, when an iron compound is used, the unoxidised ferrous salt may be titrated with a standard oxidising solution, as originally proposed by Pelouze in 1847, or the ferric salt resulting from the reaction may be determined with a reducing solution of known titre. Aromatic nitrocompounds do not interfere; apparently they remain unaffected.

Huff and Leitch[7] have treated certain nitric esters with an acidified solution of ferrous sulphate in a flask from which the air has been expelled by steam (generated by boiling a portion of water within the receptacle). In the presence of an abundant supply of hydrochloric acid and at a high enough temperature, the desired deoxidation

*Abridged from I.C. 7155 of the Bureau of Mines, U.S. Dept. of the Interior, by W. M. Thornton, Jr., Associate explosives analytical chemist, Bureau of Mines, Eastern Experiment Station, College Park, Md.

takes place and, as it would appear, *goes eventually to completion*. After evaporating the reaction mixture to a small volume and partly neutralising the acid with sodium carbonate, the operator titrates the remaining ferrous salt with a standard solution of potassium permanganate under the well-known optimum conditions. Results obtained on mannite hexanitrate (alone or in admixture with a nitrocompound) are very satisfactory, whereas those with glycerin trinitrate are somewhat too low. Huff and Leitch have sought to explain these deficiencies on the ground that the vapour tension of nitroglycerin is appreciable at 100° C. Furthermore, they have suggested certain changes in the foregoing technique that would seem to be sufficient to remedy the errors.

Becker[11], utilising a standardised solution of titanous chloride, has worked out a volumetric method that provides for the determination of both an aliphatic nitrate and an aromatic nitrocompound. A reflux condenser is attached to the reaction flask to prevent the escape of the reducible substances, and a current of carbon dioxide protects the sensitive deoxidising solutions; even so, it is necessary to make certain small corrections, depending on control experiments.

Only one of the foregoing processes for distinguishing quantitatively between the nitric esters and the aromatic nitrocompounds, the method of Hyde[8], leaves the ester chemically intact. Even here, any further treatment of the ester, dissolved in aqueous acetic acid, would seem to be difficult. Accordingly, attempts to differentiate between any two organic nitrates in an "explosive oil" appear to involve one of two assumptions: either that the nitro derivatives are absent, or that, if present, they exert but little interfering action in the proposed procedure. (As Storm[12] has pointed out, several of the nitrobodies are only partly soluble in nitroglycerin.)

Physicochemical Procedures

The aliphatic nitrate esters and the aromatic nitrocompounds exhibit distinct differences in chemical behaviour, whereas the esters—with the exception of nitrosucrose and the like, and dinitrochlorhydrin—are very similar one to another. Thus far, then, physicochemical methods usually have been brought to bear upon the problem of differentiating the latter substances. Among the physical properties that have been considered as suited to the purpose are the following: mean molecular weight, solubility, rate of evaporation, refractive index, vapour tension, and specific rotatory power with respect to polarised light.

Hyde's results for the molecular weight of nitroglycerin range from 229 to 235, and it is more than conceivable that these high numbers are due to some association of the dissolved molecules. In applying the method to the analysis of a mixture supposed to contain nitroglycerin and tetranitrodiglycerin, which had been extracted from an explosive, he concluded that the mixture comprised 29 per cent. of the more complex ester. An independent value, calculated from the proportion of nitrogen, as obtained with a nitrometer, was 33 per cent. The agreement seems reasonably good, especially in view of the fact that a departure of only 0.1 per cent. from the true nitrogen content causes an error of more than 4 per cent. in the reported quantity of tetranitrodiglycerin.

A Cryoscopic Experiment

Marqueyrol and Goutal[9] have studied the effect produced by mixtures of nitroglycerin and nitroglycol on the freezing point of benzene, and they find that the depression of this temperature (5.493° C. for the pure liquid saturated with air) decreases almost linearly with increase in the percentage of nitroglycerin. These investigators also consider the influence of several substances that may be present in the "oil" extracted from certain explosives. Of these, vaseline and dinitrotoluene (1 : 2 : 4) separate in the solid form to a large extent, hence the relatively pure liquid portion may be removed with a pipette before the cryoscopic experiment is made. On the contrary, diphenylamine and the substituted ureas remain in solution. In either event, the lowering of the freezing temperature of the solvent does not seem to be seriously vitiated by the "foreign" body, whether the ester is nitroglycerin or nitroglycol; consequently, in accordance with their data, satisfactory approximations may be expected.

Storm[12] has called attention to the greater solubility of nitroglycerin in dilute acetic acid (60 vols. of glacial acid to 40 vols. of water) as compared with nitropolyglycerin (tetranitrodiglycerin). One gram of nitroglycerin dissolves completely in about 10.5 ml. of the dilute acetic acid, but nitropolyglycerin is much less soluble. By adding the acid to a weighed quantity of the mixed esters, in small increments and with thorough agitation after each addition, the operator may dissolve virtually all the nitroglycerin and leave the nitropolyglycerin in nearly pure condition. Storm treated about 5 grams of an "explosive oil" containing approximately 2 parts by weight of nitroglycerin and 1 part of tetranitrodiglycerin with 150 ml. of the dilute acetic acid. In other words, he employed nearly three times the amount of acid needed to dissolve 5 grams of pure nitroglycerin. If the residual ester is washed and dried and if a nitrogen determination is made upon it, the value obtained should agree substantially with the theoretical percentage of that element in tetranitrodiglycerin. Speaking more broadly, if tetranitrodiglycerin has been identified by observing its resistance to dissolution in aqueous acetic acid, even though the quantity has not been estimated accurately enough, the analyst can calculate the ratio in which the two esters exist in the mixture from the nitrogen content of the original "oil"—a quantity that, presumably, has been previously established.

Refractive Indices

Rinkenbach[11] has determined the refractive indices of a number of the aliphatic nitrates at several temperatures, likewise the indices of certain pairs of the nitrates when they form a homogeneous mixture. Among these findings there are a few points that demand attention. The index of refraction for diethylene glycol dinitrate (1.4536 at 15° C.) is only slightly higher than that of its congener, nitroglycol. On the contrary, a mixture of 70 per cent. nitroglycerin and 30 per cent. nitropolyglycerin has a refractive index (1.4767 at 15° C.) even higher than that of nitroglycerin alone. Hence it should be possible to decide, with the aid of a refractometer, whether or not the nitrated glycols are present in a particular sample. Rinkenbach found, however, that the nitroglycerin extracted from a dynamite showed an abnormally high index of refraction, presumably owing to the presence of oily, fatty, and resinous matter, which freezing and filtering did not remove entirely. He decided, therefore, to recommend the refractometer either for the qualitative detection of the nitrates of the glycols or for factory-control work.

The vapour tension of nitroglycerin and of certain allied substances has been determined by a number of investigators; unfortunately, however, their published findings, in so far as they are comparable, frequently fail to agree. If the most recent work, that of Brandner[2], be taken as reliable, some interesting conclusions follow. Within the temperature range of 10° to 50° C. the vapour tension of ethylene glycol dinitrate is about 100 times that of glycerin trinitrate.

The nitrosugars differ from most organic nitrates that have been used as explosives in that they have some highly characteristic properties. Like the naturally occurring sugars, they are optically active. Hoffman and Hawse[6], as part of an extensive study of nitrosucrose (sucrose octanitrate), have found its specific rotatory power to be 56.05° at 20° C. With this datum available, the proportion of nitrosucrose, dissolved in nitroglycerin, may be approximated by means of the polarimeter. Apart from its optical activity, nitrosucrose exhibits a definite chemical behaviour. According to Taylor and Rinkenbach[13], a portion of the residual "oil" from the ether extract is dissolved in methyl alcohol, and this solution is treated with a little zinc dust and dilute hydrochloric acid. After the action has ceased the solids are allowed to settle, and the supernatant liquid is decanted and tested with Fehling's

(*Continued on page* 88.)

Personal Notes

MR. JOHN GUY HEWETT, who will be Hull's next Lord Mayor, is associated with the firm of Reckitt & Colman, Ltd.

MR. J. E. GREENWOOD, a director of Boots Pure Drug Co., Ltd., has been appointed by the President of the Board of Trade to be a member of the committee formed to advise on problems of retail trade.

MR. HUGH BEAVER, M.Inst.C.E., M.Inst.Chem.E., Director General of the Ministry of Works and Buildings, has been appointed by the Minister of Works to be chairman of a National Building Council.

SIR ROBERT ROBINSON, Waynflete Professor of Chemistry at Oxford, has been awarded the Swiss Society of Chemistry's highest honour, the Paracelsus gold medal. The presentation was made by the Swiss Minister in London, M. Thurnheer.

MR. D. LORIMER, of May & Baker (Canada), Ltd., has been elected President of the Canadian Chemical Association for 1941-2. MR. T. THORVALDSON, of the University of Saskatchewan, is the new President of the Canadian Institute of Chemistry.

MR. GERALD W. LACEY has been appointed to the post of Light Metal Controller by the Minister of Aircraft Production. Mr. Lacey will be responsible for the control of aluminium, magnesium, silicon, and light alloys. He succeeds Mr. G. Cunliffe, who was Aluminium and Silicon Controller, and Mr. G. C. Usher, who held the post of Magnesium and Light Alloys Controller.

MR. W. SINGLETON, who was recently appointed to the board of British Lead Mills, Ltd., with the position of Technical Director, was educated at Leeds and Manchester Universities, and later became an original member of the scientific staff of the G.E.C. Research Laboratories. Subsequently he joined Goodlass Wall & Lead Industries, Ltd., as research manager and technical adviser, until about two years ago when he was appointed technical manager of British Lead Mills, Ltd.

DR. F. H. CARR, C.B.E., D.Sc., F.I.C., M.Inst.Chem.E., past president, Society of Chemical Industry; past vice-president, Society of Public Analysts; vice-president, Institute of Chemistry; and past chairman and president, Association of British Chemical Manufacturers; and DR. J. VARGAS EYRE, Ph.D., M.A., member of Council, Linen Industry Research Association and Paint and Varnish Research Association of the D.S.I.R., chairman of the Solvents Committee, British Standards Inst., and president of the British Association of Chemists, have had conferred upon them the distinction of Fellow of the City and Guilds of London Institute, by the Council of the Institute.

Obituary

MR. HAROLD WILSON, one of the best known figures in the colour trade and a director of Harold Wilson and Witco, Ltd., died on July 29, aged 75.

MR. CLAUDE MACKENZIE HUTCHINSON, C.I.E., who died on August 2 near Ledbury, aged 72, was specially distinguished in the fields of agricultural chemistry and bacteriology. Practically all his working life was spent in India, where he was lecturer on agricultural chemistry at the Colonial College, and Scientific Officer to the Indian Tea Association. From 1926 to 1931 he was chief scientific adviser in India to I.C.I., Limited.

As we go to press we learn of the sudden death, in a nursing home, of DR. J. C. PHILIP, O.B.E., D.Sc., F.R.S., LL.D., Emeritus Professor of Chemistry in the Imperial College, at the age of 68. Just a month ago, Professor Philip, seeming in the best of health, and in his customary good spirits, handed over to his successor, Dr. Cullen, the Presidency of the Society of Chemical Industry, an office which he had filled with outstanding success and popularity for the last two years. The world of chemistry and of chemical industry will feel the loss of a learned and inspiring personality, and his genial presence will be greatly missed at the meetings of the Chemical Society and the Society of Chemical Industry.

Acid Mist

Three Methods of Removal

IT is a well-known but curious fact that in spite of the violent evolution of heat which takes place when liquid sulphuric acid and water are mixed, the acid when in the form of a mist may be bubbled through water practically unchanged. The reason for this phenomenon has not yet been established conclusively and there are divergent views on the subject. Two theories of this remarkable stability of acid mist are discussed by G. L. Fairs in *J.S.C.I.*, 1941, *60*, 6, p. 141. One of these postulates the existence of an adsorbed air layer on the droplets which prevents their coagulation. The other assumes that the increased vapour pressure of small droplets as compared with that of the normal liquid may be sufficiently great to approach that of the scrubbing liquid.

A comparison is made of the three main methods of mist removal available in industry, *i.e.*, by means of packed scrubbers, centrifugal separators, or electrostatic precipitators. In the case of coke-box scrubbers the chief disadvantage is their large size in relation to the volume of gas handled. They do not, however, require any attention apart from periodical repacking, and if a number of small units are installed, this does not necessitate a major shut-down of the plant. In the case of the centrifugal separator, best illustrated by the Calder-Fox scrubber, large volumes of gas may be handled by small units.. The main disadvantage is that it is not advisable to employ pressure drops in excess of 6 in. w.g. with this type of scrubber if lead scrubbing plates are used. Under favourable conditions it is possible to separate out particles of sulphuric acid down to 2μ in diameter, a scrubbing efficiency of 97 per cent. The electrostatic precipitator, such as the apparatus developed by Lodge-Cottrell, Ltd., is not limited to the separation of particles greater than 2 μ, as is shown from consideration of ionic mobilities, and scrubbing efficiencies up to 99.9 per cent. may be expected. It is noteworthy, too, that the temperature of operation has not the same importance as in the case of dust particles.

Vinyon Filters

Improved Continuity at Low Temperature

THE high resistance of Vinyon (vinyl polymer) yarn to acid and alkali attack has logically led to its development as a material for filter cloths. Some details are given in a report by W. G. Luttge of the American Viscose Corporation, in *Chem. and Met. Eng.*, 1941, *48*, 6, p. 98. Longer life and improved continuity of operation are claimed as outstanding benefits. Among successful applications recorded are the filtration of finely divided particles from strong sulphuric acid in the production of titanium dioxide, and the separation of gypsum from phosphoric acid. The paper and laundry industries are using Vinyon cloths against the oxidising action of hypochlorite solutions, where cotton and asbestos had proved unsatisfactory; and in the removal of solid particles from concentrated solutions of caustic soda Vinyon has likewise met with considerable success.

Even aqua regia and hydrofluoric acid do not attack Vinyon, which, chemically speaking, is attacked only by certain little-used ketones, esters, amines, and lower aromatic hydrocarbons; but it must be remembered that Vinyon fibres are thermoplastic and at temperatures over 65°C. the material begins to shrink, while at higher temperatures the fibres soften, lose strength, and finally tend to form a solid mass.

Cleaning the Vinyon filter cloth is an easy process, as the residue can generally be removed easily by brushing. Even the most adherent materials can be removed from the smooth continuous filaments by immersing the cloth in a strong solvent. Experiments are now being conducted in the preparation of workmen's chemical-resistant clothing made of this material.

Weekly Prices of British Chemical Products

ACTIVITY appears to be sustained in most sections of the chemical market, and delivery specifications during the past week have covered good volumes. The demand for the soda products continues on a good scale with such items as bichromate of soda and chlorate of soda in restricted supply. Offers of prussiate of soda are scarce on an increased demand. There is no change in the position of the potash materials and available supplies of these products continue to be below current requirements, this is especially so in regard to yellow prussiate of potash for which quotations are nominal. In the acid section a persistent demand is maintained for oxalic, acetic, tartaric and citric, whilst elsewhere formaldehyde is in good call and there is a steady inquiry for acetone. There have been no important changes in values to record and the undertone throughout remains firm. Generally satisfactory conditions are recorded on the market for coal tar products; creosote oil, carbolic acid crystals and cresylic acid have been in good request and both the xylols and naphthas are a strong market.

MANCHESTER.—Whilst underlying conditions on the Manchester chemical market are satisfactory in most sections, both fresh business in the leading heavy products and also the volume of inquiry have been smaller as a result of the holiday influences. On the whole, however, actual contract deliveries have been on a fair scale, whilst prices remain firm in practically every section of the market. With regard to the by-products, a well-sold position obtains in the case of most classes of materials, especially in carbolic and cresylic acids, light materials, and in crude tar and creosote oil, and a rising tendency is still in evidence.

GLASGOW.—The Scottish heavy chemical trade has recently shown slight improvement for home business, but export inquiries are still rather quiet. As from August 1 prices for several materials have again risen on account of the higher production costs.

Price Changes

Rises: Alum, Aluminium Sulphate, Antimony Sulphide, Arsenic, Cadmium Sulphide, Carbolic Acid, Cream of Tartar, Creosote, Lead Acetate, Litharge, Magnesite, Methylated Spirit, Naphtha, Naphthalene, Potassium Nitrate, Potassium Prussiate, Pyridine, Sodium Chlorate, Sodium Hyposulphite, Sodium Metasilicate, Sodium Nitrate, Sodium Silicate, Tartaric Acid, Xylol.

Falls: Ammonium Carbonate, Arsenic Sulphide, Carbon Black, India Rubber Substitutes, Sodium Phosphate, Sodium Sulphate (Salt Cake), Vermilion.

General Chemicals

Acetic Acid.—Maximum prices per ton: 80% technical, 1 ton £39 10s.; 10 cwt./1 ton, £40 10s., 4/10 cwt., £41 10s.; 80% pure, 1 ton, £41 10s.; 10 cwt./1 ton, £42 10s.; 4/10 cwt., £43 10s.; commercial glacial, 1 ton, £49; 10 cwt./1 ton, £50; 4/10 cwt., £51; delivered buyers' premises in returnable barrels, £4 10s. per ton extra if packed and delivered in glass.

Acetone.—Maximum prices per ton, 50 tons and over, £65; 10/50 tons, £65 10s.; 5/10 tons, £66; 1/5 tons, £66 10s.; single drums, £67 10s.; delivered buyers' premises in returnable drums or other containers having a capacity of not less than 45 gallons each. For delivery in non-returnable containers of 40/50 gallons, the maximum prices are £3 per ton higher. Deliveries of less than 10 gallons free from price control.

Alum.—Loose lump, £10 ton, d/d, nominal.

Aluminium Sulphate.—£10 5s. per ton d/d.

Ammonia Anhydrous.—1s. 7d. to 2s. 2d. per lb.

Ammonium Carbonate.—£32 to £39 per ton d/d in 5 cwt. casks.

Ammonium Chloride.—Grey galvanising, £22 10s. per ton, in casks, ex wharf. Fine white 98%, £19 10s. per ton. MANCHESTER: Grey galvanising, £22 10s. per ton. See also Salammoniac.

Antimony Oxide.—£68 per ton.

Arsenic.—99/100%, £35 per ton, ex store.

Barium Chloride.—98/100%, prime white crystals, £11 10s. to £13 per ton, bag packing, ex works; imported material would be dearer.

Bleaching Powder.—Spot, 35/37%, £10 7s. 6d. per ton in casks, special terms for contract.

Borax, Commercial.—Granulated, £26; crystals, £27; powdered, £27 10s.; extra fine powder, £28 10s.; B.P. crystals, £35; powdered, £35 10s.; extra fine, £36 10s. per ton for ton lots, in free 1-cwt. bags, carriage paid in Great Britain. Borax Glass, lump, £73; powder, £74 per ton in tin-lined cases for home trade only, packages free, carriage paid.

Boric Acid.—Commercial, granulated, £42 10s.; crystals, £43 10s.; powdered, £44 10s.; extra fine powder, £46 10s.; large flakes, £55; B.P. crystals, £51 10s.; powdered, £52 10s.; extra fine powdered, £54 10s. per ton for ton lots in free 1-cwt. bags, carriage paid in Great Britain.

Calcium Bisulphite.—£6 10s. to £7 10s. per ton f.o.r. London.

Calcium Chloride.—70/72% solid, £5 15s. per ton ex store.

Charcoal Lump.—£10 10s. to £14 per ton, ex wharf. Granulated, supplies scarce.

Chlorine, Liquid.—£21 7s. 6d. per ton, d/d in 16/17 cwt. drums (3-drum lots); 5½d. per lb. d/d station in single 70-lb. cylinders.

Chrometan.—Crystals, 5¼d. per lb.; liquor, £23 per ton d/d station in drums.

Chromic Acid.—1s. 2d. per lb., less 2½%; d/d U.K. GLASGOW: 1s. 0½d. per lb. for 1 cwt. lots.

Citric Acid.—1s. 2d. per lb. MANCHESTER: 1s. 6d.

Copper Sulphate.—About £29 10s. per ton f.o.b. MANCHESTER: £29 10s., less 2%, in 5 cwt. casks f.o.b. Liverpool.

Cream of Tartar.—100%, 262s. per cwt., less 2½%, d/d in sellers' returnable casks.

Formaldehyde.—£21 15s. to £25 per ton d/d. MANCHESTER: 40%, £22 to £25 per ton in casks d/d; imported material dearer.

Formic Acid.—85%, £47 per ton for ton lots, carriage paid, carboys returnable; smaller parcels quoted up to 50s. per cwt., ex store.

Glycerine.—Chemically, pure, double distilled 1260 s.g., in tins, £3 15s. to £4 15s. per cwt., according to quantity; in drums, £3 7s. 6d. to £4 1s. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hexamine.—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; carriage paid for bulk lots.

Hydrochloric Acid.—Spot, 6s. 3½d. to 8s. 9½d. carboy d/d, according to purity, strength and locality.

Iodine.—Resublimed, B.P., 9s. 11d. to 13s. 11d. per lb., according to quantity.

Lactic Acid.—Dark tech., 50% by vol., £37 10s. per ton; 80% by weight, £79; pale tech., 50% by vol. £44; 80% by weight, £86. Not less than one ton lots ex works; barrels returnable, carriage paid.

Lead Acetate.—White, £48 to £52 ton lots. MANCHESTER: £46 to £48 per ton.

Lead Nitrate.—About £45 10s. per ton d/d in casks.

Lead Red.—English, 5/10 cwt., £43 10s.; 1 cwt. to 1 ton, £43 5s.; 1/2 tons, £43; 2/5 tons, £42 10s.; 5/20 tons, £42; 20/100 tons, £41 10s.; over 100 tons, £41 per ton, less 2½ per cent., carriage paid; non-setting red lead 10s. per ton dearer in each case.

Lead White.—Dry English, less than 5 tons, £55; 5/15 tons, £51; 15/25 tons, £50 10s.; 25/50 tons, £50; 50/200 tons, £49 10s. per ton, less 5 per cent., carriage paid; Continental material, £1 per ton cheaper. Ground in oil, English, 1/5 cwt., £63 10s.; 5/10 cwt., £62 10s.; 10 cwt. to 1 ton, £62; 1/2 tons, £60 10s.; 2/5 tons, £59 10s.; 5/10 tons, £57 10s.; 10/15 tons, £56 10s.; 15/25 tons, £56; 25/50 tons, £55 10s.; 50/100 tons, £55 per ton, less 5 per cent., carriage paid.

Litharge.—1 to 2 tons, £43 per ton.

Lithium Carbonate.—7s. 9d. per lb. net.

Magnesite.—Calcined, in bags, ex works, £18 15s. to £22 15s. per ton.

Magnesium Chloride.—Solid (ex wharf), £12 to £13 per ton. MANCHESTER: £13 to £14 per ton.

Magnesium Sulphate.—Commercial £10 to £12 per ton, according to quality, ex works.

Mercury Products.—Controlled price for 1 cwt. quantities: Bichloride powder, 11s. 7d.; bichloride lump, 12s. 2d.; ammon. chloride powder, 13s. 5d.; ammon. chloride lump, 14s.; mercurous chloride, 13s. 9d.; mercury oxide, red crys., B.P., 15s.; red levig. B.P., 15s. 6d.; yellow levig. B.P., 14s. 9d.; yellow red, 14s. 4d.; sulphide, red, 12s. 11d.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 2s. 4d. per gal.; pyridinised 64° O.P. 100 gals., 2s. 5d. per gal.

Nitric Acid.—£23 to £31 per ton ex works.

Oxalic Acid.—From £60 per ton for ton lots, carriage paid, in 5-cwt. casks; smaller parcels would be dearer; deliveries slow.

Paraffin Wax.—Nominal.

Potash, Caustic.—Basic price for 50-100 ton lots. Solid, 88/92%, commercial grade, £53 15s. per ton, c.i.f. U.K. port, duty paid. Broken, £5 extra; flake, £7 10s. extra; powder, £10 extra per ton. Ex store, £3 10s. supplement.

Potassium Bichromate.—Crystals and granular 8d. per lb.; ground 7d. per lb., carriage paid. MANCHESTER and GLASGOW: 7d. per lb. in orig. casks.

Potassium Carbonate.—Basic prices for 50 to 100 ton lots; hydrated, 83/85%, £46 17s. 6d. per ton; calcined, 98/100%, £52 10s. per ton, c.i.f. U.K. port. Ex warehouse, £3 10s. extra per ton.

Potassium Chlorate.—Imported powder and crystals, ex store London, 2s. per lb.

Potassium Iodide.—B.P., 8s. 8d., to 12s. per lb., according to quantity.

Potassium Nitrate.—Small granular crystals, £40 to £45 per ton ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 5½d. per lb. for 1 cwt. lots; commercial, £7 9s. 6d. to £8 1s. 6d. per cwt., according to quantity d/d.

Potassium Prussiate.—Yellow, about 1s. 9d. to 1s. 11d. per lb., supplies scarce.

Salammoniac.—First lump, spot, £48 per ton; dog-tooth crystals, £50 per ton; medium, £48 10s. per ton; fine white crystals, £19 10s. per ton, in casks, ex store.

Soda, Caustic.—Solid, 76/77% spot, £14 17s. 6d. per ton d/d station.

Soda, Crystals.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

Sodium Acetate.—£40 per ton, ex wharf.

Sodium Bicarbonate (refined).—Spot, £11 per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 5⅜d. per lb., anhydrous, 6d. per lb., net d/d U.K. MANCHESTER and GLASGOW: 5⅜d. per lb., in orig. casks.

Sodium Bisulphite Powder.—60/62%, £17 10s. per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—£21 per ton d/d in minimum ton lots in 2 cwt. free bags.

Sodium Chlorate.—£36 to £45 per ton, d/d, according to quantity.

Sodium Hyposulphite.—Pea crystals, £19 15s. per ton for 2-ton lots; commercial £14 15s. per ton. MANCHESTER: Commercial, £14 10s.; photographic, £19 15s.

Sodium Iodide.—B.P., for not less than 28 lb., 9s. 6d. per lb.; for not less than 7 lb., 13s. 1d. per lb.

Sodium Metasilicate.—£14 5s. per ton, d/d U.K. in cwt. bags.

Sodium Nitrate.—Refined, £13 10s. per ton for 2-ton lots d/d.

Sodium Nitrite.—£24 10s. per ton for ton lots.

Sodium Perborate.—10%, £5 2s. per cwt.

Sodium Phosphate.—Di-sodium, £17 per ton d/d for ton lots. Tri-sodium, £22 per ton d/d for ton lots.

Sodium Prussiate.—From 7¼d. per lb. ex store.

Sodium Silicate.—£9 15s. per ton, for 4-ton lots.

Sodium Sulphate (Glauber Salts).—£4 10s. ton d/d.

Sodium Sulphate (Salt Cake).—Unground. Spot £4 8s. 6d. per ton d/d station in bulk. MANCHESTER: £4 13s. 6d. per ton d/d station.

Sodium Sulphide.—Solid 60/62%. Spot, £17 15s. per ton d/d in drums; crystals, 30/32%, £12 12s. per ton d/d in casks.

Sodium Sulphite.—Anhydrous, £29 10s. per ton; Pea crystals, spot, £18 10s. per ton d/d station in kegs; commercial, £12 15s. per ton d/d station in bags.

Sulphur.—Finely powdered, £18 10s. per ton d/d; precip. B.P., 68s. per cwt.

Sulphuric Acid.—168° Tw., £6 10s. to £7 10s. per ton; 140° Tw., arsenic-free, £4 11s. per ton; 140° Tw., arsenious, £4 3s. 6d. per ton. Quotations naked at sellers' works.

Tartaric Acid.—3s. 1d. to 3s. 3½d. per lb., less 5%, carriage paid for lots of 5 cwt. and upwards. MANCHESTER: 3s. 3d. per lb.

Zinc Oxide.—Maximum prices: White seal, £30 17s. 6d. per ton; red seal, £28 7s. 6d. d/d; green seal, £29 17s. 6d. d/d buyers' premises.

Zinc Sulphate.—Tech., about £20, carriage paid, casks free.

Rubber Chemicals

Antimony Sulphide.—Golden, 11½d. to 2s. per lb. Crimson, 1s. 10d. to 2s. 2d. per lb.

Arsenic Sulphide.—Yellow, 1s. 10d. to 2s. per lb.

Barytes.—Best white bleached, £8 3s. 6d. per ton.

Cadmium Sulphide.—5s. 9d. to 6s. 6d. per lb.

Carbon Black.—5¼d. to 8¼d. per lb., according to packing.

Carbon Bisulphide.—£33 5s. to £38 5s. per ton, according to quantity, in free returnable drums.

Carbon Tetrachloride.—£46 to £49 per ton.

Chromium Oxide.—Green, 1s. 6d. per lb.

India-rubber Substitutes.—White, 5 15/16d. to 8¾d. per lb.; dark, 5 9/16d. to 6 3/16d. per lb.

Lithopone.—30%, £25 per ton; 60%, £31 to £32 per ton. Imported material would be dearer.

Mineral Black.—£10 to £14 per ton.

Mineral Rubber, "Rupron."—£20 per ton.

Sulphur Chloride.—7d. per lb.

Vegetable Lamp Black.—£45 per ton.

Vermilion.—Pale or deep, 13s. per lb., for 30-lb. lots. Plus 5% War Charge.

Nitrogen Fertilisers

Ammonium Phosphate Fertilisers.—Type B, £13 18s. 9d. per ton in 6-ton lots, d/d farmer's nearest station in July.

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station: July delivery, £9 10s. Increase of 1s. 6d. per ton for every month up to £10 0s. 6d. in February, 1942; March/June, 1942, £10 2s. Rebate of 28s. per ton on present bookings for July/December delivery.

Calcium Cynamide.—Nominal: supplies very scanty.

Concentrated Complete Fertilisers.—£14 8s. 9d .per ton in 6-ton lots, d/d farmer's nearest station in July. Supplies small except C.C.F. Special.

"Nitro-Chalk."—£9 14s. per ton in 6-ton lots, d/d farmer's nearest station in July.

Sodium Nitrate.—Chilean, £13 10s. per ton in 2-ton lots, f.o.r. Liverpool; agricultural, £10 14s. per ton in 6-ton lots, d/d farmer's nearest station.

Coal Tar Products

Benzol.—Industrial (containing less than 2% of toluol), 2s. to 2s. 2d. per gal., ex works.

Carbolic Acid.—Crystals, 9½d. to 10¾d. per lb.; Crude, 60's 3s. 3d. to 4s. 6d., according to specification. MANCHESTER: Crystals, 10½d. per lb., d/d; crude, 3s. 10d. to 4s., naked, at works.

Creosote.—Home trade, 5½d. to 7d. per gal., f.o.r., maker's works; exports 6d. to 6¼d. per gal., according to grade. MANCHESTER: 5½d. to 7¼d. per gal.

Cresylic Acid.—Pale, 97/100%, 3s. per gal. MANCHESTER: Pale, 99/100%, 3s. 3d. per gal.

Naphtha.—Solvent, 90/160°, 2s. 4d. to 2s. 8d. per gal.; Heavy 90/190°, 1s. 10½d., naked at works. MANCHESTER: 90/160°, 2s. 5d. to 2s. 9d.

Naphthalene.—Crude, whizzed or hot pressed, £14 per ton; purified crystals, £27 per ton in 2-cwt. bags; flaked, £27 per ton. Fire-lighter quality, £7 10s. to £8 10s. per ton ex works. MANCHESTER: Refined, £27 per ton.

Pitch.—Medium, soft, nominal, f.o.b. MANCHESTER: Nominal.

Pyridine.—90/140°, 18s. per gal.; 90/160°, 14s.; 90/180°, 4s. to 5s. per gal., f.o.b. MANCHESTER: 14s. to 18s. per gal.

Toluol.—Pure, 2s. 5d. nominal. MANCHESTER: Pure, 2s. 5d. per gal. naked.

Xylol.—Commercial, 3s. 7d. per gal.; pure, 3s. 9d. MANCHESTER: 3s. 4d. to 3s. 10d. per gal.

Wood Distillation Products

Calcium Acetate.—Brown, £21 per ton; grey, £24. MANCHESTER: Grey, £23.

Methyl Acetone.—40.50%, £54 per ton.

Wood Creosote.—Unrefined, 2s. per gal., according to boiling range.

Wood Naphtha, Miscible.—4s. 6d. to 5s. per gal.; solvent, 5s. per gal.

Wood Tar.—£4 to £5 per ton, according to quality.

Intermediates and Dyes (Prices Nominal)

m-**Cresol** 98/100%.—Nominal.
o-**Cresol** 30/31° C.—Nominal.
p-**Cresol** 34/35° C.—Nominal.
Dichloraniline.—2s. 8½d. per lb.
Dinitrobenzene.—8½d. per lb.
Dinitrotoluene.—48/50° C., 9¾d. per lb.; 66/68° C., 1s.
p-**Nitraniline.**—2s. 5d. per lb.
Nitrobenzene.—Spot, 5½d. per lb., in 90-gal. drums, drums extra, 1-ton lots d/d buyer's works.
Nitronaphthalene.—1s. 2d. per lb.; P.G., 1s. 0½d. per lb.
o-**Toluidine.**—1s. per lb., in 8/10 cwt. drums, drums extra.
p-**Toluidine.**—2s. 2d. per lb., in casks.
m-**Xylidine Acetate.**—4s. 5d. per lb., 100%.

Latest Oil Prices

LONDON.—August 6.—For the period ending August 30 per ton, net, naked, ex mill, works or refinery, and subject to additional charges according to package and location of supplies:—LINSEED OIL, raw, £41 10s. RAPESEED OIL, crude, £44 5s. COTTONSEED OIL, crude, £31 2s. 6d.; washed, £34 5s.; refined edible, £35 12s. 6d.; refined deodorised, £36 10s. SOYA BEAN OIL, crude, £33; refined deodorised, £37. COCONUT OIL, crude, £28 2s. 6d.; refined deodorised, £31 7s. 6d. PALM KERNEL OIL, crude, £27 10s.; refined deodorised, £30 15s. PALM OIL, refined deodorised, £37; refined hardened deodorised, £41. GROUNDNUT OIL, crude, £35 10s.; refined deodorised, £40. WHALE OIL, crude hardened, 42 deg., £30 10s.; refined hardened, 42 deg., £33. ACID OILS.—Groundnut, £19; soya, £17; coconut and palm kernel, £22 10s. ROSIN, 32s. to 42s. per cwt., ex wharf, according to grade. TURPENTINE, 68s. 6d. per cwt., spot, American, including tax, ex wharf, in barrels, and ex discount.

LIVERPOOL.—August 5.—TURPENTINE, spot, American, 70s. per cwt.

General News——From Week to Week

Imperial Chemical Industries, Ltd., have undertaken to give £3000 a year for seven years to the R.A.F. Benevolent Fund.

The names of eleven employees of The Gas Light & Coke Company are included in the list of awards for gallantry in civil defence, published last Saturday.

The new address of the Food Machinery & Chemical Plant Export Group is 39 St. James's Street, London, S.W.1. Tel.: REGent 3471.

The Department of Scientific and Industrial Research has issued a further summary of current literature (Vol. XIV, No. 1) of the Water Pollution Research Board, dated January, 1941, and comprising Abstracts Nos. 1—145 (price 2s.).

The use of wild-rose hips and other hedgerow products as a source of vitamin C is to be encouraged this autumn, according to a reply given by Major Lloyd-George to a question by Dr. Summerskill in the Commons last week.

A big Scottish factory owned by Imperial Chemical Industries, Ltd., has raised over £84 for the Treasury by surrendering railings, 21 tons of which were taken down and sold. Other firms are being asked to follow this example.

The British Association's division for the social and international relations of science is arranging meetings for September 26-28, when subjects under the heading "Science and World Order" will be dealt with.

A consolidated list of acids, chemicals and drugs made in Canada, incorporated in a memorandum dated June 6 and issued by the Dominion Department of National Revenue, may be inspected by persons interested, at the Department of Overseas Trade, Millbank, London, S.W.1.

At the annual general meeting of Boots Pure Drug Co., Ltd., Lord Trent, the chairman, announced that 27 of the company's employees had lost their lives while serving with H.M. Forces, and 17 through enemy action at home. A chemist employed by the firm had been awarded the George Cross, and another employee had received the George Medal.

The Ministry of Food announces that there will be no change in the existing prices of oils and fats, allocated to primary wholesalers and large trade users, for the four weeks ending August 30, 1941, with the exception of palm oil acid oil. The price of this oil is still under consideration, and will be announced later.

The Sir Henry Fildes Medal and Commendation of the Institution of Factory Managers will be awarded in 1941 for the best essay on "Factory Welfare." Entries should be submitted by registered post, before September 1, and should be addressed to the Secretary of the Institution, L. M. Angus-Butterworth, Ashton New Hall, Ashton-on-Mersey, Cheshire, from whom full details are obtainable.

Foreign News

The Russian Government, it is reported, has purchased 200 flasks of mercury in the open market.

Of the iron ore exported from Brazil in April, 23,730 long tons in all, 15,950 tons were shipped to the U.K. by the Cia. Serviços de Engenharia, S.A.

Owing to the bad hay crop in Sweden, a campaign has been started for the collection of leaves, reeds, etc., for use as animal fodder, stated the Stockholm radio recently.

Deposits of barytes, said to be of considerable extent and of high purity, were discovered near Windsor, Nova Scotia, recently.

Increased imports into Nicaragua of insecticides of the dinitro-orthocresol type are envisaged, to deal with grasshopper pests, if experiments now being conducted should prove successful.

Carbonyl iron powder is now being produced by the General Aniline Works at Grasselli, N.J. This powder is mainly for use in electrical devices, but grades for other applications also will soon be available.

Imports of aluminium sulphate into Brazil fell from 4425 metric tons in 1939 to 3384 in 1940. The decrease is mainly attributable to domestic production, the municipality of Bello Horizonte (for example) having erected a plant in 1939 for the manufacture of aluminium sulphate for water purification.

Cinnabar deposits in the Torres district of the State of Lara, Venezuela, with a mercury content reckoned at 7.86 per cent., are reported to have been acquired for exploitation by a Caracas concern. It is said that the requisite plant is being purchased, ready to start operating at the end of 1941.

The International Nickel Co. is to spend $25,000,000 in the next three years on plant extension. Plans both to increase the production and reduce non-essential consumption are to be worked out by a Canadian-United States Materials Co-ordination Committee.

It was announced recently by the U.S. Department of Commerce that creosote oil imports during the first quarter of 1941 declined sharply to 5,324,000 gallons, against 12,200,000 gallons for the same period of 1940. The total imports for 1940 were 39,000,000 gallons, of which the U.K. supplied 97 per cent.

Sodium sulphate was exported from Chile to the amount of 6860 metric tons in the first 4 months of 1941—a considerable increase over the 1675 tons recorded in the corresponding months of 1940. The United States continued to be the chief purchaser during the 1941 period, taking 5873 tons. Brazil took 526 and Argentina 365.

The following commodities have been made subject to export licence from the United States to Great Britain: Bromine and mercury (not including conversions and derivatives); cobalt nitrate; mica; optically clear plastics; platinum group metals; quartz crystals; caffeine, theobromine, and theophylline; and uranium.

The Dominion Rubber Co., Ltd., of Canada, have co-operated with the Naugatuk Chemical Corporation of the United States Rubber Co. in the formation of a new body known as Naugatuk Chemicals Ltd., Elmira, Ontario. The new concern's plant will produce aniline oil, accelerators, anti-oxidants, and other chemicals vital to the rubber industry.

Domestic production of mercury in the United States amounted to 3600 flasks in May, 100 flasks above March and April, and only 100 flasks below the peak for recent years of 3700 in December, 1940, according to the U.S. Bureau of Mines. Consumption, which dropped sharply from 4000 flasks in March to 3200 in April, rose again to 3500 in May. Price quotations for spot metal in May stood at $180—183 a flask.

A threatened lack of ferrous scrap in the United States has led to a forecast that steel ingot production there will drop to about 90 per cent. of capacity in the autumn. According to Reuter, quoting the *Iron Age*, last week's production stood at 99 per cent., compared with 99.5 per cent. the previous week. Meanwhile, a blast-furnace programme for increasing pig-iron capacity by 6,500,000 tons provides a safeguard against long-range shortage.

The nutrient value of the phosphorus in defluorinated phosphate, calcium metaphosphate, and other phosphatic materials has been determined by K. D. Jacob and W. H. Ross, of the Fertiliser Research Division, U.S. Bureau of Agricultural Chemistry and Engineering. Results of their investigations have been published separately, and can be obtained (price 8c., including foreign postage) from the Superintendent of Documents, Government Printing Office, Washington, D.C.

The world's first automatic residual chlorinator, which makes possible the most effective control of water sterilisation ever recorded, has been successfully developed by the New Haven (Conn.) Water Company after more than ten years of experiment. By means of a sensitive cell which measures the electrical current in a flowing sample of water, the apparatus automatically varies the dosage of chlorine according to changing conditions in the water from the reservoirs. Until now chlorine has been added merely in proportion to the amount of water being used.

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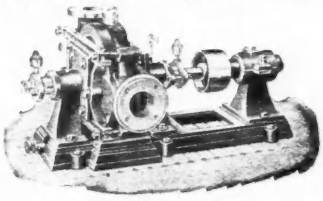

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(*Continued from page 82.*)

reagent. A bright-red precipitate of cuprous oxide indicates reducing sugar (derived from the original nitrosugar). In lieu of zinc and acid, ammonium sulphide may be employed as the deoxidising agent. The present writer is unaware of any attempt to extend this procedure to the quantitative estimation of a nitrosugar.

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NOTE.—Only the most important references to the literature are included here. A much fuller list appears in the original publication.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

County Court Judgment

CHEMICAL ENGINEERING AND WILTONS PATENT FURNACE CO., LTD., Old House, London Road, Horsham. (C.C.J., 9/8/41.) £33 19s 6d. May 20.

Company Winding-Up Voluntarily

BRITISH NATURAL RESINS, LTD. (C.W.U.V., 9/8/41.) July 16. F. J. T. Thompson, 8 Southampton Row, W.C., appointed liquidator.

Company News

Anglo-Egyptian Oilfields, Ltd., announce a net profit for 1940 of £236,254 (£223,941).

Sangers, Ltd., have declared a final dividend on ordinary stock of 15 per cent., making 22½ per cent. for the year (25 per cent.).

The International Nickel Co. have declared a dividend of 50 cents per share on the common stock (same as for previous quarter).

Hadfields, Ltd., have declared an interim dividend of 7½ per cent. on the ordinary stock (same). Last year's interim was followed by a final dividend of 15 per cent.

Lansil, Ltd., announce a net profit for the year ended March 29 of £77,093 (£166,934), and have declared a dividend on ordinary shares of 6 per cent. (same).

Blythe Colour Works, Ltd., have decided to withhold payment of an interim dividend on ordinary shares until the results of the full year's trading are available.

The Metal Box Co., Ltd., has declared a final dividend of 10 per cent. and a bonus of 2½ per cent., both less tax, making 17½ per cent. for the year ended March 31 (same).

Chemical and Allied Stocks and Shares

AIDED by slightly more active conditions in the stock and share markets, and the continued firmness of British Funds, security values have tended to make improved prices. Among industrial shares rather more attention was given to securities of companies which seem likely to pay satisfactory dividends during the period of the war, although buying was selective in character and was inclined to centre on the higher yielding issues. In many instances, however, stocks and shares have continued to be firmly held and remained in small supply in the market. Consequently, prices have shown strong response in some cases on very moderate demand. It is realised that owing to E.P.T. at 100 per cent. and the higher income tax, reduced dividends must be expected, and that apart from the strength of the balance-sheet position and similar considerations, the dividend policy of individual companies will be governed by the view of the directors as to the likely trend in earnings. Consequently, in many instances an even larger proportion of net profits may be added to reserve funds. Moreover, in some directions a point may be approaching when output is reaching its maximum level under war conditions.

Imperial Chemical at 31s. 10½d. were a few pence higher on balance, the belief having continued that the interim dividend is likely to be kept at 3 per cent. I.C.I. preference units at 32s. 1½d. were virtually the same as a week ago. B. Laporte changed hands at 60s. at one time, and were quoted at 58s. 9d. following the announcement of the proposed increase in the issued capital. Fison Packard were again around 32s., while Borax Consolidated deferred units remained a steady feature at 28s. 6d. Elsewhere, Barry and Staines further improved to 31s. 6d., and Nairn and Greenwich were 1s. 3d. higher at 57s. 6d. Moreover, Wall Paper deferred units further improved to 25s., a gain of 1s., the market being hopeful of a moderate improvement in the dividend. Some attention continued to be given to Triplex Glass on the possibility of better financial results, and these 10s. shares were a few pence higher at 20s. 9d. Awaiting the interim dividends, British Aluminium were better at 46s. 3d., while British Oxygen were firm at 67s. 6d. Business at 12s. 3d. was recorded at one time in Burt, Boulton and Haywood, and British Glues 4s. shares transferred at 5s. 9d. Blythe Colour were 4s. 7½d. following the decision not to pay an interim dividend; it may be recalled that last year the question of a dividend was also left until the final payment. In other directions, British Match moved up 6d. to 35s. British Drug Houses were firm at 22s. 6d., while Monsanto Chemicals 5½ per cent. preference were also 22s. 6d., and Greeff-Chemicals Holdings 5s. shares remained around par; but as in many other directions, quotations do not appear to have been tested by business at the time of writing. Awaiting the interim dividend, Associated Cement improved to 56s. 3d. British Plaster Board were active around the higher level of 16s. 9d.

There was more activity in iron, steel and allied securities, and Allied Ironfounders continued their improvement with a rise to 19s. Moreover, Babcock and Wilcox were better at 44s. 6d., as were Dorman Long at 22s. 3d., while Tube Investments were 94s. 9d. Richard Thomas preference shares rose strongly to 16s. 9d. on the full year's dividend announced on this class of capital. Textile securities moved better on the expectation that recent developments will make for much reduced competition from Japan in export markets. Calico Printers, Bradford Dyers and Fine Cotton Spinners were better, but on the other hand, Courtaulds had a slightly easier appearance at 30s. 7½d. Among other securities, Imperial Smelting and General Refractories, at 11s. 3d. and 9s. 6d. respectively, held their recent gains. Awaiting publication of the full financial results, Beechams Pills 2s. 6d. deferred shares were steady at 8s. 9d. Boots Drug were firmer at 35s. 9d., and Lever and Unilever improved to 25s. 3d., while Lever N.V. were 20s. Sangers remained around 15s. 9d.; the dividend on these 5s. shares is 22½ per cent., compared with the 25 per cent. paid last year. Anglo-Iranian, Burmah Oil, "Shell" and most other leading oil shares moved better in accordance with the prevailing tendency on the Stock Exchange, but best prices recorded in the past few days were not fully maintained.